BASIC PROGRAM INFORMATION

Program Review is about documenting the discussions and plans you have for improving student success in your program and sharing that information with the college community. It is also about linking your plans to decisions about resource allocations. With that in mind, please answer the following questions.

Program/Department Name: NANO (Nanoscience)

Division Name: PSME - Physical Science Math and Engineering

Please list all team members who participated in this Program Review:

Name	Department	Position
Robert D. Cormia	ENGR	Faculty

Number of Full Time Faculty: 1 **Number of Part Time Faculty:** 0

Please list all existing Classified positions: *Example: Administrative Assistant I*

Sherman Lee (Evening Chemistry Lab Technician; assisting when technically needed)

SECTION 1: PROGRAM REFLECTION

1A. Program Update: Based on the program review data, please tell us how your program did last year. We are particularly interested in your proudest moments or achievements related to student success and outcomes.

In 2014-15 we added NANO10, Nanoscience, to the program, teaching at Palo High School (PAHS) in Fall 2014, and Gunn High School in Spring 2015 (semesters). We also are teaching the course again at PAHS in Fall 2015, and recently (informally) have been asked if we want to develop the program further at PAHS. Enrollments at PAHS are slightly higher than at Gunn, but this course will add 20-30 total students per year, and has the potential to grow as a science elective. Last year also saw the strongest enrollment in all of the advanced courses. Analysis of enrollment in the program post NSF funding showed that a significant number of students who take one advanced course will take a second or third, and total certificate completers in the second cohort were equal to or slightly higher than in the first, suggesting that students who take one course will probably take a second or third.

1B. Program Improvement: What areas or activities are you working on this year to improve your program? Please respond to any feedback from the supervising administrator from last year's program review.

Program improvement is a continuous process, with new content added to each lecture in most quarters. In Fall 2015 we reordered NANO51 to add commercialization and 4D printing, bringing this class more in alignment with NANO10 (Introduction to Nanoscience). Last year we added NANO62 to curriculum, as an advanced course that integrates NANO52 (Nanomaterials and Nanostructures) NANO53 (Nanocharacterization tools) and NANO54 (Nanofabrication tools) making it easier for working students to integrate structures, fabrication, and characterization. This course will have NANO51 (Nanotechnology Applications) as a recommended prerequisite. We may add a microscopy lab to the program to make a small certificate. During Fall 2016, faculty Robert Cormia will modify NANO10 (Nanoscience) to become a lab course at Foothill College, while continuing to teach it at a high school. If Cormia's sabbitcal project is approved, we may also add nanoengineering activities developed at NASA-

ASL (Advanced Studies Laboratory) We are also working with Dawn Girardelli to see if a version of any of these courses could be taught as a workforce class at the new Sunnyvale education center (satellite campus). The goal here is to expose nanoscience as a course to multiple community colleges with our partners West Valley Mission College District.

1C. Measures of Success: What data or information will you use to measure your success (e.g. student success rates, changes in student or program learning outcomes)?

Student success is measured in class completion, quality of assignents, promotion in the workforce, and or placement in an internship or research position. Date from this year show about 75 to 80% completions, with minimal withdrawal rates. Students who fall behind in assignments generally do not succeed, while those with greater discipline tend to succeed. A key challenge in success rates is simply the amount of time that students have to put into class. Generally, academic students (working on matriculation and transfer) to better in assignments and student learning outcomes, however that's not a uniform observation. Upper division and graduate students tend to do very well, and some working students (with better discipline) also do well.

1D. EMP Goal: The 2015-2020 Educational Master Plan (EMP) includes the following goal:
"Create a culture of equity that promotes student success, particularly for underserved students."

Based on the program review data, tell us some of the things your program will be doing this year to support this goal. You will be asked to report on any accomplishments on your next comprehensive program review.

Suppurting underserved students is a key goal of our program, and early in a quarter I look for activities where I can increase student contact, such as in our Saturday microscopy lab. A key challenge for students is their outside work environment, and ability to stay focused in class. Underserved students tend to be younger, which presents a challenge in our more advanced classes. The single most important activity that increases performance of underperforming students is faculty-student rapport in class. Regardless of ethnicity, age, or academic ability, talking with students, meeting with them before or after class, working with them in the Saturday microscopy sessions, helps each of us (student and faculty) discuss the learning challenges and come up with ideas to increase completion of assignments. It is also a time to talk with them about workforce interests.

SECTION 2: PROGRAM OBJECTIVES & RESOURCE REQUESTS

2A. New Program Objectives: Please list any new objectives (do not list your resource requests).

Program Objective	Implementation Timeline	Progress Measures
Example: Offer 2 New Courses to Meet Demand	*Winter 2016 Term*	*Course Enrollment*
Create NANO62 (integrated advanced course, potentially taught hybrid)	Summer and Fall 2016 (sabbatical)	Completion of COR & Curriculum Approval
Enhance NANO10 with new activites and laboratories, potentially to be offered at Foothill for engineering / STEM students	Spring Semester (Gunn) and Summer Fall 2016 (sabbatical)	Development of laboratory notebook

2B. Resource Requests: Using the table below, summarize your program's unfunded resource requests. Refer to the Operations Planning Committee (OPC) website for current guiding principles, rubrics and resource allocation information.

Resource Request	$	Program Objective (Section 2A)	Type of Resource Request			
			Full-Time Faculty/Staff Position	One-Time B-Budget Augmentation	Ongoing B-Budget Augmentation	Facilities and Equipment
			☐	☐	☐	☐

2C. Unbudgeted Reassigned Time: Please list and provide rationale for requested reassign time.

None - using a proposed sabbatical (2015-16) to shift NANO10 from a High School activity course to a Foothill College lab course, and develop more hands-on activities at NASA-ASL for nanoengineering projects.

SECTION 3: LEARNING OUTCOMES ASSESSMENT SUMMARY

3A. Attach 2014-2015 Course-Level Outcomes: Four Column Report for CL-SLO Assessment from TracDat. Please contact the Office of Instruction to assist you with this step if needed.

3B. Attach 2014-2015 Program-Level Outcomes: Four Column Report for PL-SLO Assessment from TracDat. Please contact the Office of Instruction to assist you with this step if needed.

SECTION 4: FEEDBACK AND FOLLOW-UP

This section is for the Dean/Supervising Administrator to provide feedback.

4A. Strengths and successes of the program as evidenced by the data and analysis:

Robert Cormia (who primarily teaches the Nanoscience courses) is a dedicated faculty member who spends much time ensuring rich personal interactions with students, as well as advocating for research opportunities and connections with NASA and other outside agencies. With the incorporation of NANO 10 and placing it at PAHS and GHS, enrollment has doubled from the previous year by 100% (44 to 88), which has subsequently increased WSCH (+161%). Students in the program continue to receive certificates of proficiency, with 2013-2014 resulting in 24 certificates being issued, but a marked dropped off in the 2014-2015 AY. Course success rates remain high (74%, 3-year average) overall, with similar rates when disaggregated between targeted (86%, n= 14) and non-targeted groups (79%, n = 73).

NANO 10 is a great introduction for students to science due to its interdisciplinary nature of merging chemistry, physics, and material science enginering, and adapting the course for the main campus will provide another GE Natural Science option for students. NANO 10 also provides an opportunity for students to explore a career in science, as well as a upskilling pathway for individuals already possessing college degrees. The open microscopy lab on Saturdays is popular with students and the occassional science enthusiast from the community. The Nanotechnology program has been diligent in maintaining partnerships with other organizations such as NanoLINK, Minnesota State University, and NASA.

4B. Areas of concern, if any:

Despite its successes, the Nanotechnology program faces certain issues due to its relatively small size:

1. Although enrollment in the department has jumped from 44 to 88 duplicated students (64 unduplicated) over the past year, this is a very limited number of students served by a program which offered five different courses (NANO 10, 51, 52, 53, 54). As such, productivity is at 162 (3-year average), but did see an increase in 2014-2015.

2. The Nanotechnology program is greatly enhanced by research connections between NASA and other agencies; however, much of this is spear-headed by a single faculty member. Dependence on only one faculty member to maintain these relationships does raise concerns about program viability if he is absent. Robert Cormia and the Nanotechnology program have been Foothill's de facto connection to NASA after the discontinuation of the Foothill-NASA AMES internship program.

3. Future growth of the program is a concern. Although multiple plans have been laid out in this PR (e.g., NANO 10 at the Main Campus, replacement with NANO 62, program placement at the Sunnyvale Center targeting work force), because nanotechnology transfer programs are limited with job growth also being tepid, the audience that the Nanotechnology program is targeting may be small or difficult to reach.

4C. Recommendations for improvement:

Improvements to the three concerns stated above:

1. Offering NANO 10 at the local high schools should continue as students' schedules are determined well in advance to help project enrollment numbers. In order to build demand and increase productivity, NANO courses may be offered on alternating years. Maintaining the popular Saturday microscopy labs is recommended, if possible, in some form.

2. With funding from outside sources (or SLI), potentially re-establish and institutionalize a research program with NASA (or another agency) so that a robust internship program can be maintained without the burden on one faculty member's shoulders.

3. Maintaining NANO 10 courses at the local high schools and offering it on the main campus will hopefully build visibility and interest. An internship with a private employer (versus government agency) may help to garner greater interest and be used to assist with marketing efforts. Collaborating with the Marketing department as well as Outreach are other possible avenues to explore.

4D. Recommended Next Steps:

☒ Proceed as Planned on Program Review Schedule
☐ Further Review / Out-of-Cycle In-Depth Review

Upon completion of Section 4, the Program Review document should be returned to department faculty/staff for review, then submitted to the Office of Instruction and Institutional Research for public posting. Please refer to the Program Review timeline.

Unit Course Assessment Report - Four Column

Foothill College

Department - Nanotechnology (NANO)

Mission Statement: Provide technicians training for students and working professionals practicing nanomaterials engineering

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
Department - Nanotechnology (NANO) - NANO 10 - INTRODUCTION TO NANOTECHNOLOGY - Applications - students will describe the industrial applications of nanotechnology, with specific instances (applications) in semiconductors, high performance materials, (and suggested) energy, food, water, computing, and medicine - assessment by written evaluation. (Created By Department - Nanotechnology (NANO)) **Start Date:** 09/01/2011 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	**Assessment Method:** Students write a midterm assignment studying an application of nanotechnology including analysis of an industrial application, a company working in that area, and the technical approach taken to solve that problem. **Assessment Method Type:** Case Study/Analysis **Target for Success:** Ability to communicate a problem space (industrial application) and why it is important, the reason behind the technical approach taken, and how a company will bring this particular solution into the market place.	06/30/2015 - At both Palo Alto HS and Gunn HS, students were able to identify the applications of nanotechnology, principally through group projects. **Result:** Target Met **Year This Assessment Occurred:** 2014-2015 **Resource Request:** N/A	
Department - Nanotechnology (NANO) - NANO 10 - INTRODUCTION TO NANOTECHNOLOGY - Field of Nanotechnology - students will describe the field of nanotechnology from a historical perspective, and emergent / convergent from physics, materials science and engineering, semicondutors and electronics, biology and chemistry - assessment by written evaluation (Created By Department - Nanotechnology (NANO)) **Course-Level SLO Status:** Active	**Assessment Method:** Weekly writing assignment **Assessment Method Type:** Discussion/Participation **Target for Success:** Ability to communicate the history and contest of Nanotechnology, as integrative of but also distinct from chemistry, physics, and materials science	06/30/2015 - Students at both Palo Alto and Gunn HS were mostly able to define the field of nanoscience and nanotechnology, however in our after school venue at Gunn HS, this was a more difficult task. We'll add more videos and perhaps guest speakers. **Result:** Target Met **Year This Assessment Occurred:** 2014-2015 **Resource Request:** N/A	
Department - Nanotechnology (NANO) - NANO 10 - INTRODUCTION TO NANOTECHNOLOGY - Material Engineering - students will describe the material	**Assessment Method:** Weekly writing assignment **Assessment Method Type:** Discussion/Participation	06/30/2015 - At both Palo Alto and Gunn HS students were able to articulate the need for advanced materials in the key application areas of energy, food, water, computing, and medicine,	

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
engineering and application challenges in energy, food, water, computing, and medicine - assessment by written evaluation. (Created By Department - Nanotechnology (NANO)) **Course-Level SLO Status:** Active	**Target for Success:** Ability to communicate the need for new materials and materials engineering solutions in the field of energy, food, water, computing, and medicine.	through group projects and presentations. However, we didn't assess for an understanding of all of the application areas. Will need to reword the assignment. **Result:** Target Met **Year This Assessment Occurred:** 2014-2015 **Resource Request:** N/A **Resource Request:** N/Ahttps://foothill.tracdat.com/tracdat/faces/assessment/observations/editObservation.jsp#	
Department - Nanotechnology (NANO) - NANO 10 - INTRODUCTION TO NANOTECHNOLOGY - Nanoengineering - students will describe how nanotechnology and nanoengineering are practiced in industry, including thin film deposition, particle size, distribution, and surface area, grain boundary engineering, lattice dimension / strain - students will describe the material engineering and application challenges in energy, food, water, computing, and medicine - assessment by written evaluation. (Created By Department - Nanotechnology (NANO)) **Course-Level SLO Status:** Active	**Assessment Method:** Weekly writing assignment **Assessment Method Type:** Discussion/Participation **Target for Success:** Ability to communicate how nanotechnology and nanomaterials engineering is used in industry, and specifically the technical approaches to solving problems in application development.	06/30/2015 - The student learning outcome for nanoengineering was much stronger at Palo Atlo HS than at Gunn HS. This was most likely because of the different venue (period 5/7 at Palo Atlo vs after school at Gunn) **Result:** Target Met **Year This Assessment Occurred:** 2014-2015 **Resource Request:** N/A	
Department - Nanotechnology (NANO) - NANO 10 - INTRODUCTION TO NANOTECHNOLOGY - Nanostructures - students will identify ten key nanostructures, how they are prepared, and why they are important in nanoscience and materials engineering - assessment by written evaluation.	**Assessment Method:** Weekly writing assignment **Assessment Method Type:** Discussion/Participation **Target for Success:** Students will identify and define ten key nanostructures and why they are important	06/30/2015 - Palo HS students were able to identify nearly ten structures, while Gunn HS students were only able to identify six to eight. The level of detail/recall was better for Palo Alto HS, again a reflection of the more academic setting for this course. **Result:**	

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
(Created By Department - Nanotechnology (NANO)) **Course-Level SLO Status:** Active	in nanotechnology. Can including structure => property relationships as well as industry applications	Target Met **Year This Assessment Occurred:** 2014-2015 **Resource Request:** N/A	
Department - Nanotechnology (NANO) - NANO 10 - INTRODUCTION TO NANOTECHNOLOGY - PNPA Rubric - students will learn and apply the PNPA rubric to key application and product engineering challenges - as a method for applying the engineering method to advanced materials engineering - assessment by written evaluation. (Created By Department - Nanotechnology (NANO)) **Course-Level SLO Status:** Active	**Assessment Method:** Final writing assignment **Assessment Method Type:** Research Paper **Target for Success:** Ability to integrate the PNPA rubric into an industry application (nanotechnology or area of research (nanoscience). Demonstrate understanding of processing => structures => properties => applications	06/30/2015 - We reworded the final writing assignment, and actually removed this as a goal in our two offerings of NANO10. It would have required too much effort, especially at the end of the course when we were running out of time. We do introduce PNPA at a number of points in the class, and across the NANO program, students do master this concept. **Result:** Target Not Met **Year This Assessment Occurred:** 2014-2015 **Resource Request:** N/A	
Department - Nanotechnology (NANO) - NANO 10 - INTRODUCTION TO NANOTECHNOLOGY - Properties Relationships - students will apply theory of atomic, electronic, and material structure to Modeling and Simulation, Engineering, and Structure - Properties Relationships. (Created By Department - Nanotechnology (NANO)) **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignment **Assessment Method Type:** Discussion/Participation **Target for Success:** Ability to describe how particular properties emerge from molecular/electronic structures etc., and a general understanding of structure => property relationships.	06/30/2015 - This SLO was way too challenging for students given the limited amount of time that we have in this class. We'll probably bolster our molecular modeling demonstration and lab, with an emphasis on visualization of molecular structure and chemical bonding. **Result:** Target Not Met **Year This Assessment Occurred:** 2014-2015 **Resource Request:** N/A	
Department - Nanotechnology (NANO) - NANO 10 - INTRODUCTION TO NANOTECHNOLOGY - Fabricating Nanostructure - students will identify the	**Assessment Method:** weekly writing assignments **Assessment Method Type:** Discussion/Participation	06/30/2015 - This SLO was also too challenging for a younger student without any understanding of tools used in industry. We also had very little time to work on this. However, we did have a field	

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
primary process tools for fabricating nanostructured materials, how they work, and where they fit into both academic research and industrial laboratories and manufacturing. (Created By Department - Nanotechnology (NANO)) **Course-Level SLO Status:** Active	**Target for Success:** Ability to identify basic approaches to nanofabrication from a tools and process perspective. May integrate a notion of key nanostructures, properties, and applications.	trip at Gunn HS to a thin film facility (Southwall Technologies) that was quite memorable. We'll scale back the fabrication tools SLO. **Result:** Target Not Met **Year This Assessment Occurred:** 2014-2015 **Resource Request:** N/A	
Department - Nanotechnology (NANO) - NANO 10 - INTRODUCTION TO NANOTECHNOLOGY - Characterization Tools and Methods - students will identify the primary process tools for characterizing nanostructured materials, how they work, and where they fit into both academic research and industrial laboratories and manufacturing (QA/QC). (Created By Department - Nanotechnology (NANO)) **Start Date:** 09/01/2011 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignment **Assessment Method Type:** Discussion/Participation **Target for Success:** Ability to identify typical instruments and methods used in characterizing nanomaterials, nanostructures, and elucidating structure property relationships.	06/30/2015 - We spent a lot of time on this SLO at both Palo Alto and Gunn HS, and also had a tour of Stanford University's nanocenter. Students did quite well on this, as measured by their identification of tools, spectra, and ability to name/identify acronyms. **Result:** Target Met **Year This Assessment Occurred:** 2014-2015 **Resource Request:** N/A	
Department - Nanotechnology (NANO) - NANO 10 - INTRODUCTION TO NANOTECHNOLOGY - Emergent and Converget Nanotechnology - students will identify and discuss the current challenges to nanotechnology and nanoengineering in policy, education, funding, legal, and environmental applications and identify and discuss the future emergent and convergent areas of nanotechnogy, including quantum computing, synthethic biology, and IT/MEMS (nanorobotics) (Created By Department - Nanotechnology (NANO)) **Course-Level SLO Status:**	**Assessment Method:** weekly writing assignment **Assessment Method Type:** Discussion/Participation **Target for Success:** Describe the convergence of nanotechnology, biology, physics, etc., and the legal and policy implications of nanotechnology. Identify where funding of research is needed.	06/30/2015 - We will eliminate this SLO as we ran out of time to cover the advanced fields in nanoscience and nanotechnology. We'll replace it with easier topics (3D printing), nanomedicine, and only a slight coverage of synthetic biology. **Result:** Target Not Met **Year This Assessment Occurred:** 2014-2015 **Resource Request:** N/A	

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
Active			
Department - Nanotechnology (NANO) - NANO 51 - APPLICATIONS OF NANOTECHNOLOGY - Fundamental Concepts of Nanoscience - What are (some of the) fundamental tenants of nanoscience? (Emergence of properties at scale, self-assembly, surface area effects, and emergence of nanosystems). (Created By Department - Nanotechnology (NANO)) **Start Date:** 01/01/2012 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignments and midterm/final writing assignments **Assessment Method Type:** Exam - Course Test/Quiz **Target for Success:** Describe key ideas / concepts in nanoscience and how / why they are important in nanotechnology. Three key ideas are self-assembly, surfaces, and emergence of properties at scale.		
Department - Nanotechnology (NANO) - NANO 51 - APPLICATIONS OF NANOTECHNOLOGY - Key Nanostructures used in Nanotechnology - What are the 10-20 key nanostructures used in industry? (Apply PNPA to each in a top-level manner) (fullerenes, nanotubes, thin films, and dendrimers) (Created By Department - Nanotechnology (NANO)) **Start Date:** 01/01/2012 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignments and midterm/final essays **Assessment Method Type:** Exam - Course Test/Quiz **Target for Success:** Describe ten to twenty key nanostructures and how and why they are used in industry. Include a description of PNPA processing => structures => properties => applications, and how PNPA is used in industry / nanomaterials engineering.		
Department - Nanotechnology (NANO) - NANO 51 - APPLICATIONS OF NANOTECHNOLOGY - Fundamental Applications of Nanotechnology - What are the fundamental problems addressed and industries using nanoscience and nanoengineering? Use PNPA, and how does it relate to the actual hands-on practice of nanomaterials engineering? (Created By	**Assessment Method:** midterm/final writing assignment **Assessment Method Type:** Case Study/Analysis **Target for Success:** Describe fundamental problems in industry requiring novel materials / properties, and how / where nanomaterials engineering is used to find solutions to those problems.		

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
Department - Nanotechnology (NANO)) **Start Date:** 01/01/2012 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	Integrate PNPA: processing => structures => applications => properties into the discussion of nanomaterials engineering for application development.		
Department - Nanotechnology (NANO) - NANO 52 - NANOMATERIALS & NANOSTRUCTURES - Key Nanostructures used in Nanotechnology - What are the key 10 to 12 nanostructures used in nanotechnology, and what are their composition and structure. Why are they important and what industries use them to solve what types of problems? (Created By Department - Nanotechnology (NANO)) **Start Date:** 01/01/2012 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignments and midterm/final writing assignment **Assessment Method Type:** Exam - Course Test/Quiz **Target for Success:** Describe ten to twelve key nanostructures in terms of their elemental composition, molecular and electronic structures, and how/why they are important in nanoscience and nanotechnology. Integrate PNPA (fundamental structure => properties)	06/30/2015 - Students are able to describe a dozen or more key nanostructures, their key properties, how to process/characterize, and structure property relationships. **Result:** Target Met **Year This Assessment Occurred:** 2014-2015 **Resource Request:** N/A **GE/IL-SLO Reflection:** N/A	
Department - Nanotechnology (NANO) - NANO 52 - NANOMATERIALS & NANOSTRUCTURES - Structure => Property Relationships - How do properties arise from key nanostructures? Using the systems archetype model: networks of atoms, systems of physics, and emergence of properties at scale. (Created By Department - Nanotechnology (NANO)) **Start Date:** 01/01/2012 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignment **Assessment Method Type:** Exam - Course Test/Quiz **Target for Success:** Ability to describe fundamental interactions (physics) at the level of molecular and electronic structure that lead to the emergence of properties, and specific structure => property relationships. Ideally integrate the nanopatterns pedagogy of networks of atoms => systems of physics => and emergence of properties at scale.	06/30/2015 - This SLO is met by students with a good chemistry foundation, however for students without advanced chemistry, this can be a little difficult. We may need to add new curriculum for this SLO. **Result:** Target Met **Year This Assessment Occurred:** 2014-2015 **Resource Request:** N/A **GE/IL-SLO Reflection:** N/A	
Department - Nanotechnology (NANO) - NANO 52 - NANOMATERIALS & NANOSTRUCTURES - Characterization and	**Assessment Method:** midterm/final writing assignments **Assessment Method Type:**	06/30/2015 - Students performed very well on this assignment, some with just one year of chemistry, if they paid attention to the lectures and followed	

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
Fabrication of Key Nanostructures - What are the primary fabrication and characterization tools for the key 10 - 12 nanostructures used in nanotechnology? (Created By Department - Nanotechnology (NANO)) **Start Date:** 01/01/2012 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	Exam - Course Test/Quiz **Target for Success:** Ability to describe process and characterization tools and methods for fabricating and characterizing key nanostructures. Ideally integrate PNPA rubric: process => structures => properties => applications that tie tools to structure => properties.	the required reading. **Result:** Target Met **Year This Assessment Occurred:** 2014-2015 **Resource Request:** N/A **GE/IL-SLO Reflection:** N/A	
Department - Nanotechnology (NANO) - NANO 53 - NANOMATERIALS CHARACTERIZATION - Structure Characterization Tools - What combination of instruments are used to characterize the composition, chemistry, and structure of a material? (Created By Department - Nanotechnology (NANO)) **Start Date:** 09/01/2011 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignments and midterm/final writing assignment or project **Assessment Method Type:** Exam - Course Test/Quiz **Target for Success:** Describe the selection and use of characterization tools to determine composition, chemistry, structure of a material, to support process development, and FA/QA/QC of nanomaterials and devices.		
Department - Nanotechnology (NANO) - NANO 53 - NANOMATERIALS CHARACTERIZATION - Property Characterization Tools - What combination of instruments are used to characterize the physical properties of materials? How are structure-property relationships determined? (Created By Department - Nanotechnology (NANO)) **Start Date:** 09/01/2011 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignments and midterm/final writing assignment or project **Assessment Method Type:** Exam - Course Test/Quiz **Target for Success:** Describe key tools and methods for determining material properties (physical, electrical, optical, magnetic, etc.) and elucidation of structure => property relationships		

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
Department - Nanotechnology (NANO) - NANO 53 - NANOMATERIALS CHARACTERIZATION - Approaches to Failure Analysis and Materials Characterization - What are are typical approaches to failure analysis, materials characterization, and QA/QC (for nanostructures, nanomaterials, devices and industries)? (Created By Department - Nanotechnology (NANO)) **Start Date:** 09/01/2011 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignments and midterm/final writing assignment or project **Assessment Method Type:** Exam - Course Test/Quiz **Target for Success:** Describe approaches to failure analysis, materials characterization, and QA/QC using specific tools for key problems/devices in targeted industries.		
Department - Nanotechnology (NANO) - NANO 54 - NANOFABRICATION TOOLS & PROCESS - Process Tools and Techniques - What are the key process tools and techniques used to fabricate nanomaterials and nanostructures? (Created By Department - Nanotechnology (NANO)) **Start Date:** 01/01/2012 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignments and midterm/final writing assignment or project **Assessment Method Type:** Exam - Course Test/Quiz **Target for Success:** Describe key process tools and techniques for fabrication of nanomaterials and devices used in high technology industry (semiconductors, magnetic media, biomedical devices, etc). Explain why specific tools and processes are used.	03/30/2015 - Students have challenges with this SLO, and most likely because we don't have a hands-on component where they can see the process equipment. Students who participate in internships are able to identify two-three tools fairly well **Result:** Target Not Met **Year This Assessment Occurred:** 2014-2015 **Resource Request:** We need to fund internships at NASA-ASL **Resource Request:** We need to fund (more) internships at NASA-ASL **GE/IL-SLO Reflection:** N/A **GE/IL-SLO Reflection:** N/A	
Department - Nanotechnology (NANO) - NANO 54 - NANOFABRICATION TOOLS & PROCESS - Process Optimization - What are the key methods and approaches to	**Assessment Method:** weekly writing assignments and midterm/final writing assignment or project **Assessment Method Type:**	03/30/2015 - Process optimization is also challenging, as we need extended time on this topic. For students with hands-on activities, this is straightforward but requires critical thinking, and	

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
process optimization, including optimizing process => structure => properties (Created By Department - Nanotechnology (NANO)) **Start Date:** 01/01/2012 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	Exam - Course Test/Quiz **Target for Success:** Describe approaches for process optimization, including diagraming process intervention points, characterization tools, and tying structure => property relationships to to process => structure relationships, and demonstrating the turnkey / interlocked relationships in the PNPA rubric.	some experience with both processing equipment and characterization tools. **Result:** Target Not Met **Year This Assessment Occurred:** 2014-2015 **Resource Request:** Need hands-on experience with process tools	
Department - Nanotechnology (NANO) - NANO 54 - NANOFABRICATION TOOLS & PROCESS - Process Reproducibility - What are the key methods and approaches to achieving process reproducibility, and what QA/QC methods are also employed in that process? (Created By Department - Nanotechnology (NANO)) **Start Date:** 01/01/2012 **End Date:** 01/01/2013 **Course-Level SLO Status:** Active	**Assessment Method:** weekly writing assignments and midterm/final writing assignment or project **Assessment Method Type:** Exam - Course Test/Quiz **Target for Success:** Describe methods and approaches to achieving process reproducibility, including flow charts, process diagrams, and points of intervention, for nanofabrication and processing (manufacturing) in high-tech related industries (semiconductors, thin films, magnetic media, and biomedical devices).	03/30/2015 - This SLO will require reworking the curriculum, adding a section on process reproducibility, etc. We'll probably rewrite SLOs and incorporate this into a larger SLO. **Result:** Target Not Met **Year This Assessment Occurred:** 2014-2015 **Resource Request:** N/A	
Department - Nanotechnology (NANO) - NANO 62 - NANOMATERIALS ENGINEERING - STRUCTURES, PROCESSING & CHARACTERIZATION - Nanostructures - Identify a dozen nanostructures, their key properties (structure-property relationships), and why they are important in advanced materials engineering. (Created By Department - Nanotechnology (NANO)) **Course-Level SLO Status:** Inactive			
Department - Nanotechnology (NANO) -			

Course-Level SLOs	Means of Assessment & Targets for Success / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
NANO 62 - NANOMATERIALS ENGINEERING - STRUCTURES, PROCESSING & CHARACTERIZATION - Nanofabrication - For each of the dozen nanostructures, identify a fabrication technique, including equipment, process materials, and process steps (Created By Department - Nanotechnology (NANO)) **Course-Level SLO Status:** Inactive			
Department - Nanotechnology (NANO) - NANO 62 - NANOMATERIALS ENGINEERING - STRUCTURES, PROCESSING & CHARACTERIZATION - Nanocharacterization - For each nanostructure, identify a characterization tool and a procedure for determining structure, composition, chemical bonding, and support for process development. (Created By Department - Nanotechnology (NANO)) **Course-Level SLO Status:** Inactive			

Unit Assessment Report - Four Column

Foothill College

Program (PSME - NANO) - Nanoscience AS/CA

PL-SLOs	Means of Assessment & Target / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
Program (PSME - NANO) - Nanoscience AS/CA - Nanoscience / Nanotechnology Competency - Technicians will apply foundational nanoscience principles to understanding and further learning about nanostructures, properties, and engineering solutions (read and apply literature, seminars, and webinars). Demonstrate through written assignments (diagrams etc.), term papers, and class presentations. Use PNPA as a way to read and learn from technical writing articles **Year PL-SLO implemented:** End of Quarter **Start Date:** 01/01/2012 **End Date:** 01/01/2013 **SLO Status:** Active	**Assessment Method:** Students use case studies in nanoscience (research) and nanotechnology (commercial applications) to demonstrate an understanding of the relationships between processing => structure => properties => applications, and how scientists and engineers leverage structure => property relationships for nanomaterials selection, and how new fabrication methods produce novel nanostructures with unique / tailored properties. **Assessment Method Type:** Case Study/Analysis	12/07/2015 - Students have used case studies effectively throughout NANO51 (applications) NANO52 (structures) NANO53 (Characterization) and NANO54 (fabrication) to describe the use of the PNPA rubric in integrated materials engineering. In NANO10 (Nanoscience) younger students understand this if we spend time on it **Result:** Target Met **Year This Assessment Occurred:** 2014-2015 **Resource Request:** N/A **Resource Request:** N/A **GE/IL-SLO Reflection:** N/A **GE/IL-SLO Reflection:** N/A	
Program (PSME - NANO) - Nanoscience AS/CA - Nanomaterials Engineering - Technicians will develop effective engineering plans for developing materials engineering solutions for industrial applications (using PNPA). These include applying characterization skills to elucidating structure=> property relationships, process optimization (for desired properties) and consistent material manufacturing. Demonstrate through term projects (diagrams etc.), engineering lab experiments, and class presentations, **Year PL-SLO implemented:** End of Quarter	**Assessment Method:** Students will demonstrate an understanding of effective nanomaterials engineering practice through class lab projects where they will design / describe / document a path from processing => structure => (characterization) => properties => applications. **Assessment Method Type:** Class/Lab Project	12/07/2015 - This SLO requires students to participate in a laboratory course with access to equipment. In NANO54, we discuss engineering plans, but this is somewhat difficult to provide effective instruction for. We are rethinking this in our program redesign during Winter Qtr 2016, and over a proposed sabbatical for Robert Cormia. **Result:** Target Not Met **Year This Assessment Occurred:** 2014-2015 **Resource Request:** Need hands-on experience with process tools **Resource Request:**	

PL-SLOs	Means of Assessment & Target / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
Start Date: 01/01/2012 **End Date:** 01/01/2013 **SLO Status:** Active		Need hands-on experience with process tools	
Program (PSME - NANO) - Nanoscience AS/CA - Nanotechnician Competency - Technicians will support fundamental R&D, process development, characterization (including QA/QC FA etc.) and consistent / good manufacturing practice (in all sizes of high technology firms). Demonstrate through internship and work experience. **Year PL-SLO implemented:** End of Quarter **Start Date:** 01/01/2012 **End Date:** 01/01/2013 **SLO Status:** Active	**Assessment Method:** Students will demonstrate an ability to effectively practice the integrated nanomaterials engineering method (PNPA rubric) in a working / research environment. Students will practice processing/fabrication, characterization, and working to develop/optimize a fabrication/processing method. Could be capstone experience in a laboratory, internship, or incumbent working experience. **Assessment Method Type:** Field Placement/Internship	12/07/2015 - We placed two students into paid positions during this time period, but lack internships to help other students practice knowledge and learn OJT skills. We need to fund more internships at NASA-ASL. This is part of a proposed sabbatical for Robert Cormia in 2015-16 (pending approval by the sabbatical committee). **Result:** Target Not Met **Year This Assessment Occurred:** 2014-2015 **Resource Request:** We need to fund (more) internships at NASA-ASL **Resource Request:** We need to fund (more) internships at NASA-ASL	
Program (PSME - NANO) - Nanoscience AS/CA - Nanosystem Competency - Understand nanostructures as nanosystems: extended (ordered or patterned) networks of atoms and forces, from which properties emerge at scale. [[This PLO is reduced to 'inactive' as we don't really have curriculum in place to teach this. We may add this as an SLO for NANO52 if the pedagogy is effective for an SLO.]] **Start Date:** 01/01/2012 **End Date:** 01/01/2013 **SLO Status:**	**Assessment Method:** Students will submit a research paper showing an understanding of nanostructures as networks of atoms, systems of physics, and emergence of properties at scale. This is an advanced concept in nanoscience and an emerging pedagogical tool. **Assessment Method Type:** Research Paper **Target:** 50 to 80% of students will master this concept in a targeted research paper.	12/07/2015 - This is an advanced concept and the SLO/PLO will be removed at the end of the cycle. One NANO student (with an MS in mathematics) presented this topic paper at the Materials Research Society (MRS) in Boston, and has chosen to apply her mathematics knowledge (topology and graph theory) to advanced materials engineering. **Result:** Target Not Met **Year This Assessment Occurred:** 2014-2015 **Resource Request:** N/A **Resource Request:**	

PL-SLOs	Means of Assessment & Target / Tasks	Assessment Findings/Reflections	Action Plan & Follow-Up
Inactive		N/A	